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Morgan

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[54] **APPARATUS AND METHOD FOR MONITORING REMOTE SECURITY ZONES**

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[51] **Int. Cl.**[3] **H04Q 9/00;** G08B 29/00

[52] **U.S. Cl.** **340/825.36;** 340/502; 340/525; 340/825.1

[58] **Field of Search** 340/825.32, 825.36, 340/825.1, 502, 505, 506, 518, 541, 525

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,958,240	5/1976	Richardson, III	340/525
4,023,139	5/1977	Samburg	340/506
4,067,008	1/1978	Sprowls, III	340/825.1
4,117,479	9/1979	Galvin et al.	340/502
4,339,746	7/1982	Ulicki et al.	340/518

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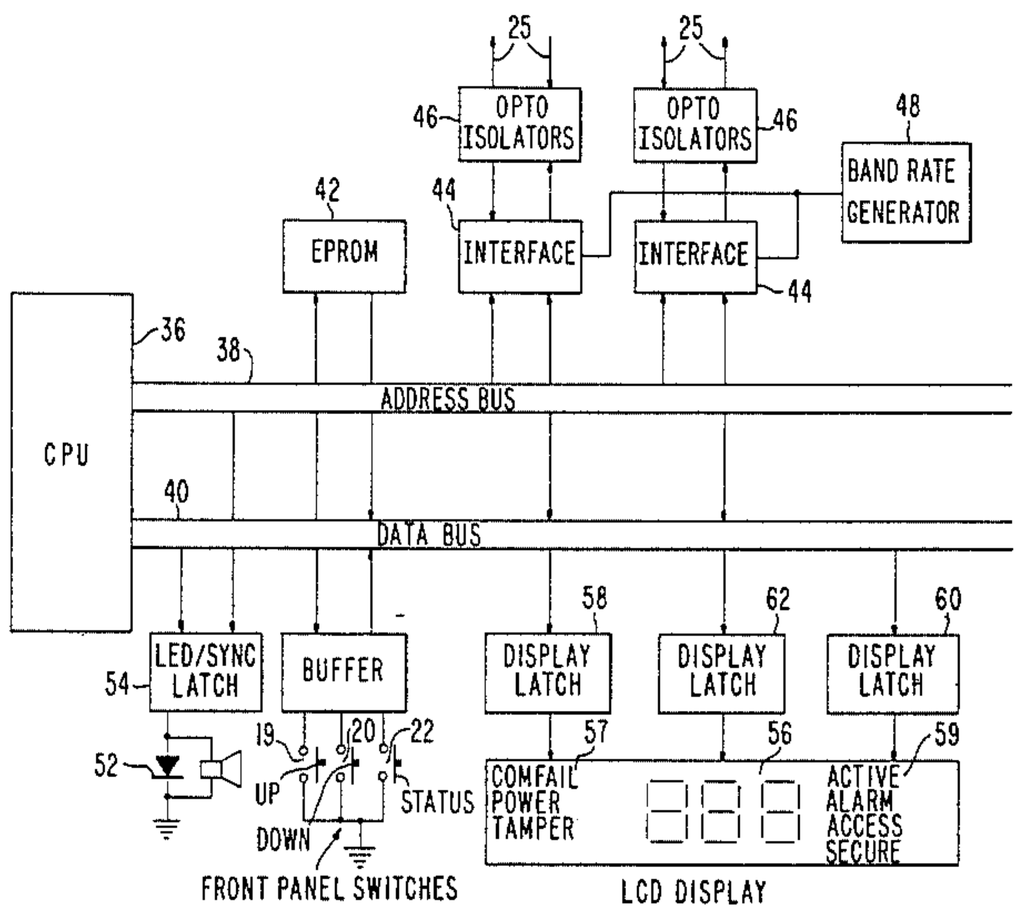
[57] **ABSTRACT**

Apparatus and a method for detecting the actuation of any of a plurality of security sensors at respective zones remotely spaced from a central control location and for displaying information representing the operating status of a zone whose sensor has been actuated. The apparatus comprises a control unit having a central processor and an input coupled to a transponder bus to which a plurality of remote transponders are connected, each transponder having a number of security sensors associated therewith. The control unit further includes a visual display having a first portion for displaying sequentially the identifying numbers assigned to the remote zones and a second portion for displaying the operating status of a zone whose identifying number is shown on the first portion of visual display. When a sensor is actuated at one of the zones, the central processor of the control unit causes the identifying number of the zone and the status of the zone to be displayed simultaneously. The control unit also displays information as to whether the sensor actuation at the zone is continuous or of short duration. By actuation of a status switch on the control unit, an operator can acknowledge a change in the status of the zone and return the display to its initial status condition before or after taking steps to correct any action which caused the status change at the zone. The control unit can also display information which indicates a power failure, a line problem, or a tampering of the equipment.

7 Claims, 4 Drawing Figures



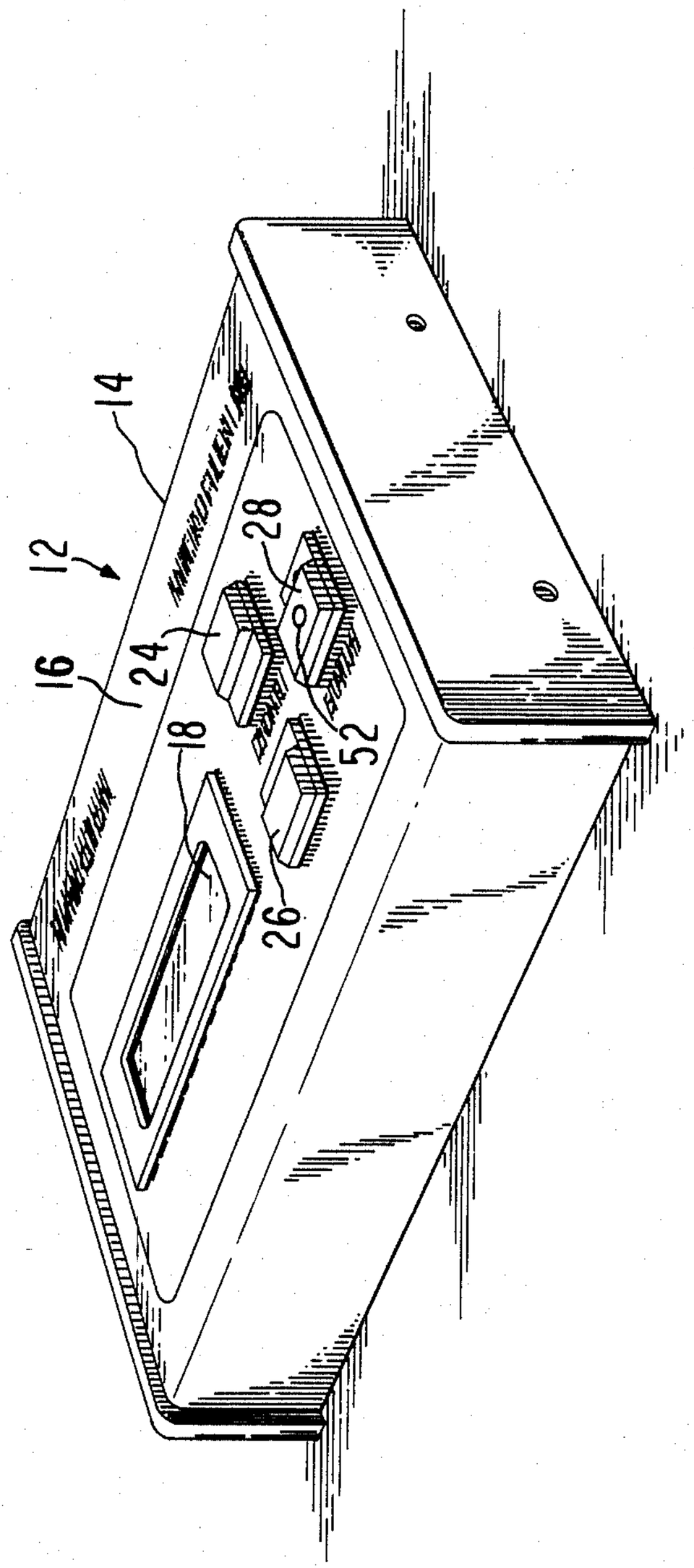


Fig. 1.

FIG. 2

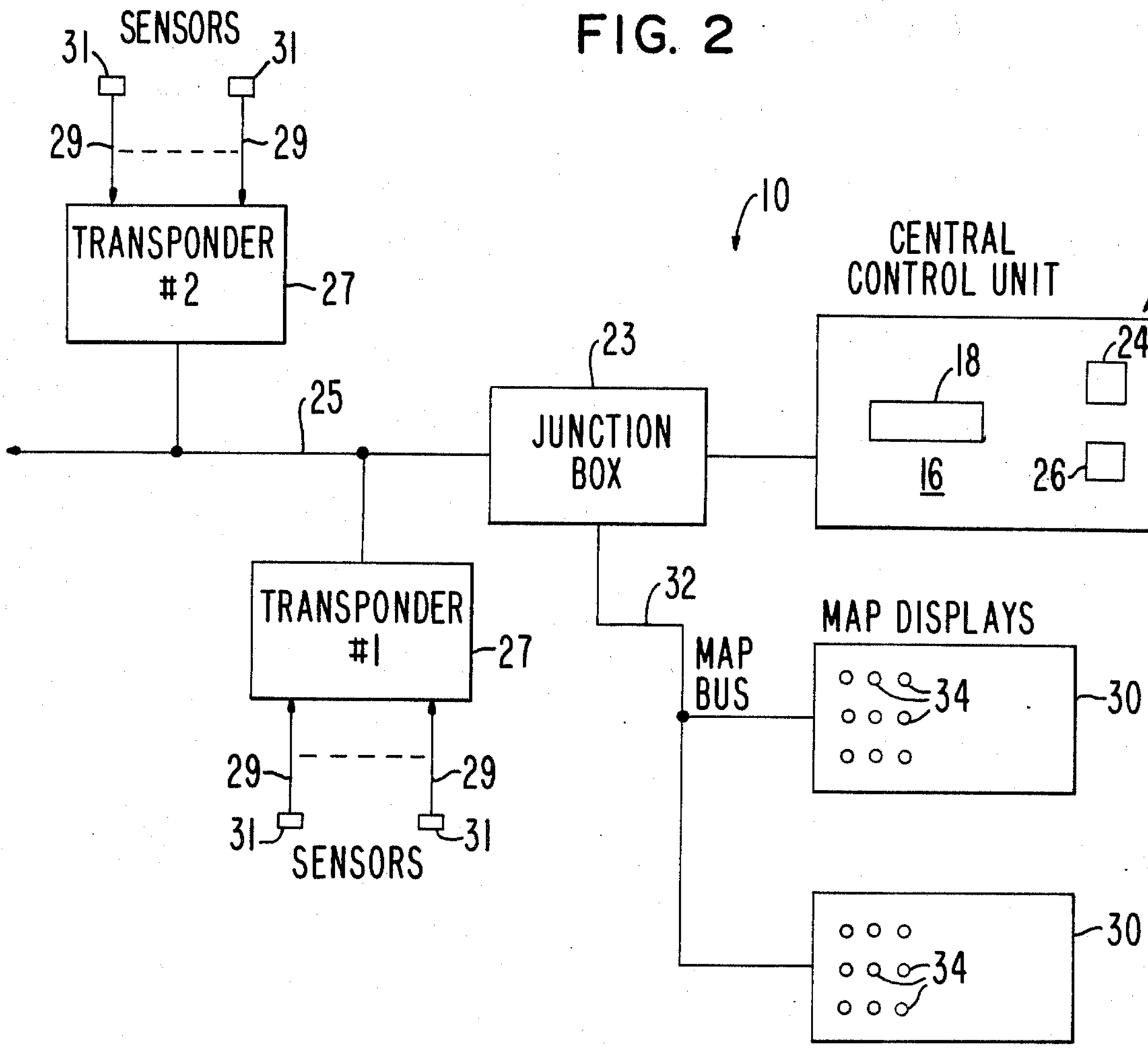
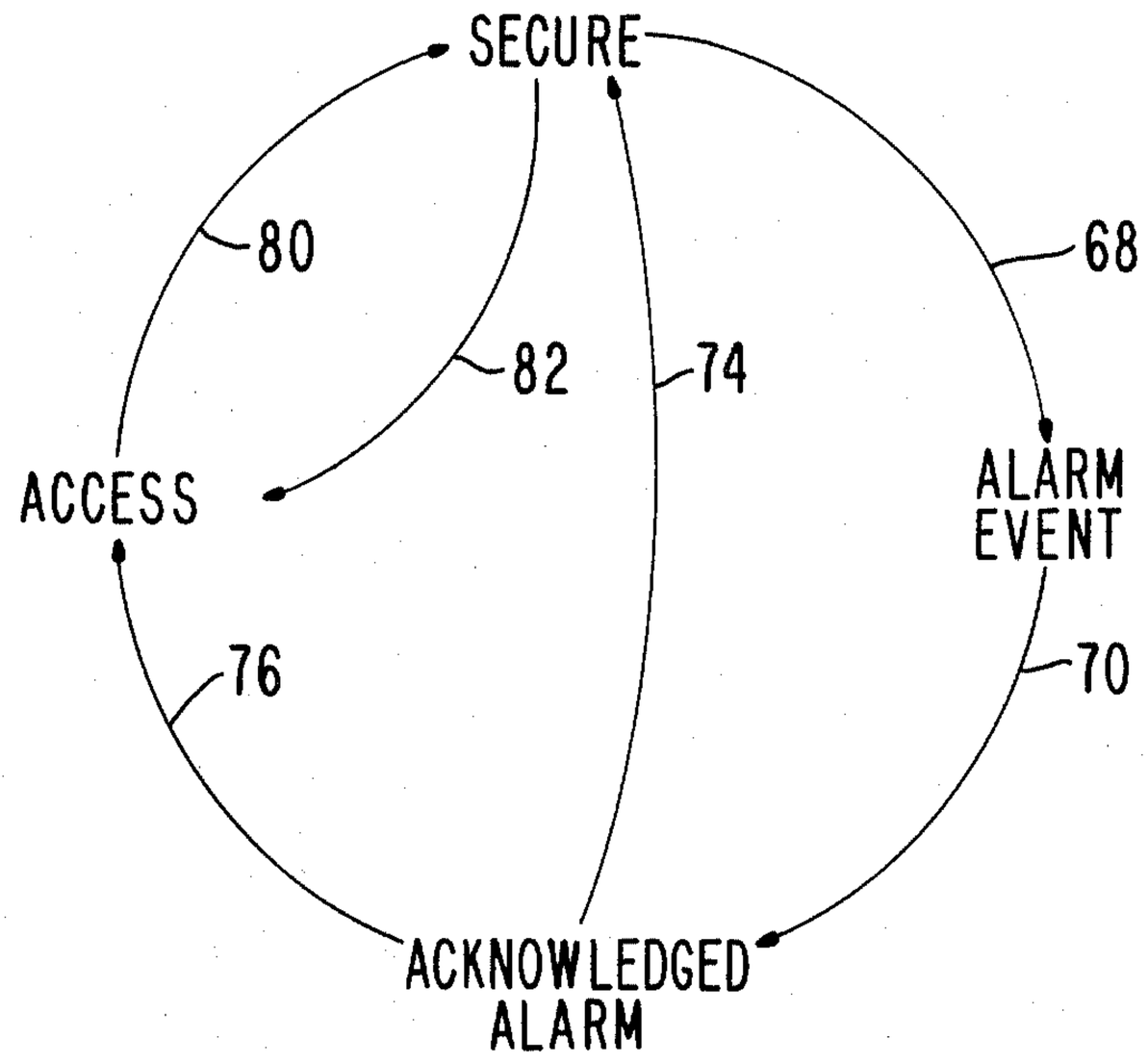

SENSORS
31
31
29
29
TRANSPONDER #2
27
25
23
JUNCTION BOX
18
24
52
16
26
28
10
CENTRAL CONTROL UNIT
12
TRANSPONDER #1
27
32
MAP BUS
MAP DISPLAYS
34
30
29
29
31
31
SENSORS
34
30

FIG. 4


SECURE
80
82
74
68
ACCESS
ALARM EVENT
76
70
ACKNOWLEDGED ALARM

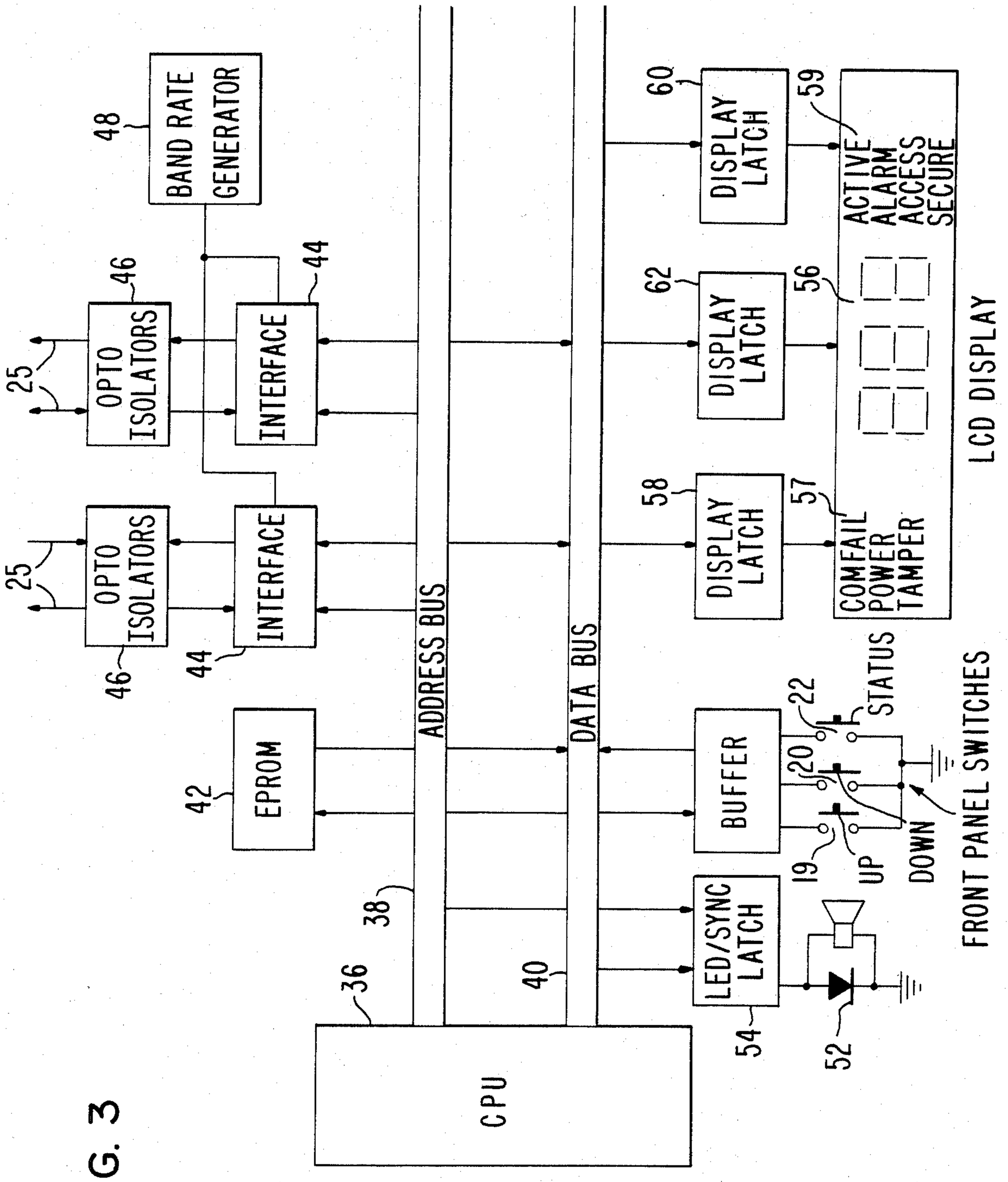

CPU
ADDRESS BUS
DATA BUS
36
38
40
EPROM
42
BAND RATE GENERATOR
48
OPTO ISOLATORS
46
INTERFACE
44
25
BUFFER
LED/SYNC LATCH
54
DISPLAY LATCH
60
DISPLAY LATCH
62
DISPLAY LATCH
58
ACTIVE ALARM ACCESS SECURE
59
56
COMFAIL POWER TAMPER
57
LCD DISPLAY
STATUS
22
20
19
UP
DOWN
FRONT PANEL SWITCHES
52

FIG. 3

APPARATUS AND METHOD FOR MONITORING REMOTE SECURITY ZONES

This invention relates to improvements in the monitoring of remote locations by security devices and, more particularly, to apparatus and method for monitoring a plurality of remote security zones spaced from a central control location and for displaying the status of such zones in a sequential fashion.

BACKGROUND OF THE INVENTION

Remote zones have been monitored for security purposes in the past by placing sensors at the zones and having communication lines extending from the sensors to a central control location. Changes in the operating conditions of the sensors can be detected by the actuation of visual or sound indicators at the central control location. However, systems of conventional design for carrying out these purposes have been complex in construction and costly to manufacture and operate. For this reason, a need has arisen for improvements in monitoring systems for a plurality of remote zones which give information about status changes of remote zones and permit the monitoring of the zones without requiring special skills and without the need for complex circuitry.

SUMMARY OF THE INVENTION

The present invention satisfies the aforesaid need by providing an improved apparatus and method for monitoring the operating status of a plurality of remote security zones spaced from a central control location. The apparatus includes a control unit having a central processor which receives signals on a transponder bus from a plurality of transponders. Each transponder has a number of input sensors at respective, remote security zones for automatic actuation when changes at the zones occur. The central processor, when it receives a signal from a remote sensor, actuates a visual display and a sonic alert indicator to provide an indication of a change in the operating status of the zone and the operating status of the sensor at the zone. The operator of the system can take immediate action after becoming aware of such changes to meet any challenge presented by the changes after obtaining the information displayed by the control unit.

The information displayed by the control unit can be changed by the manipulation of a status switch on the control unit. In this way, a single actuation switch on the control unit can cause the processor to display not only the status of a zone whose status has changed, but also cause the processor to display the operating status of the sensor at the zone as to whether the sensor actuation is continuous or of short duration. The processor can also permit any one of the zones to be accessed, i.e., to permit entry to the zone, without causing an alarm event to occur at the zone.

The present invention provides a monitor system which is simple and rugged in construction, is inexpensive to manufacture, install and maintain, and is capable of being used by individuals with no special skills. The system is also useful for a large number of remote security zones so that the cost of operating the system per zone is minimal.

The primary object of the present invention is to provide an apparatus and method for monitoring remote security zones spaced from a central control location wherein any change in the status of a zone will be sensed and indicated immediately on a display at the central control location whereupon an operator of the system can take remedial action as required when a change occurs and, to signify such action, can actuate a single status switch at the central control location which will cause the display to indicate whether the change at the remote zone is continuous or of short duration, yet the displayed status of the zone can be returned to its initial state, all to the end that the system is simple to operate and is economical to produce and maintain.

Other objects of this invention will become apparent as the following specification progresses, reference being had to the accompanying drawings for an illustration of the invention.

IN THE DRAWINGS:

FIG. **1** is a perspective view of a central control unit for the security system of the present invention;

FIG. **2** is a block diagram of the central control unit in combination with a number of sensors at remote zones spaced from the central control unit and map displays near the control unit for simultaneously indicating the status of the sensors at the remote locations;

FIG. **3** is a block diagram of the components of the central control unit; and

FIG. **4** is a graphic view of the sequence of steps in determining the status of a remote security zone and its sensor.

The present invention comprises a multiplex monitor and display system and is broadly denoted by the numeral **10**. System **10** is adapted to provide status information relating to a plurality of remote, spaced security zones to be monitored, such as various locations throughout a warehouse or large plant. The system comprises a control unit **12** shown in FIGS. **1–3**, the control unit adapted to be placed at a central location and including a housing **14** provided with a front panel **16**. A liquid crystal display **18** is mounted on panel **16** adjacent to three push button control switches **19**, **20** and **22** (FIG. **3**) having respective pushbuttons **24**, **26** and **28** (FIG. **1**) projecting outwardly from front panel **16**. The control unit is comprised of a number of components, including a central processor **36**, as shown in FIG. **3** which will hereinafter be described.

FIG. **2** shows control unit **12** coupled by a junction box **23** and a transponder bus **25** with a plurality of transponders **27**, each transponder having a number of inputs **29** from sensors **31** at remote zones to be monitored by system **10**. As an optional feature, system **10** can be provided with map displays **30**, coupled by a map bus **32**, to junction box **23** so that a visual display, such as displays formed by LED's **34**, can be formed which represent the status of zones **31** whose sensors are coupled by leads **28** to the inputs of respective transponders **27**. Thus, there is an optional map display **30** for each transponder **27**, respectively, if desired.

Control unit **12** is shown in more detail in FIG. **3** and includes central processing unit **36**, such as a 6802 CPU having an internal ram of 128 bytes. An address bus **38** and a data bus **40** extend outwardly from the CPU and are coupled to other components of control unit **12**. Address bus **38** is coupled to an EPROM **42** which stores a program for operating system **10**. A number of interface units **44** are coupled to address bus **38** and data bus **40** and receive data from sensors **31** at respective, remote zones through opto-isolator units **46**. The leads

coupled with units **46** form parts of transponder bus **25**. A baud rate generator **48** is coupled with interface units **44** to control the receipt of data directed thereto from opto-isolator units **46**.

Data bus **40** is coupled with switches **19**, **20** and **22** through a buffer **50**. Switch **22** has an LED **52** coupled with its push-button **28** (FIGS. **1** and **2**) and this LED is coupled through an LED/sync latch **54** to address bus **38** and data bus **40**. A sonic alert indicator **55** also is coupled to data bus **40** through latch **54**.

FIG. **3** also shows liquid crystal display **18** on the front panel **16** of housing **14**. The liquid crystal display, can display three 7-segment numerical digits in a central portion **56** of the display and can display seven different words. Three words can be displayed in a portion **57** to the left of central portion **56**, and four words can be displayed in portion **59** to the right of central portion **56**. These seven words are comfail, tamper, power, active, alarm, access and secure. Display latches **58**, **60** and **62** are coupled with the word portions **57** and **59** and central portion **56**, respectively. Display latches **58** are coupled also to data bus **40**.

Control switches **19** and **20** (FIG. **3**) sequence the display of the identifying numbers assigned to various remote zones **31** up and down and cause changes in the numerals displayed by the digits in central portion **56** of display **18**. Switch **22** defines a system status switch which is actuated to change the status of a zone whose identifying number is displayed on display **18**.

Immediately upon the application of power to system **10**, control unit **12**, under the control of central processor **36**, scans bus **25** to determine which of the remote zones, which can be as many as **128** zones, are actually in the system. This scanning action is done by sequentially actuating status switch **22** by the operator and one of the two switches **19** and **20**.

The identifying number of each active zone in the system is displayed in display **18** whenever an alarm event affects that zone. An alarm event occurs at a zone when the security sensor at that zone is actuated. Each sensor can be of any desired construction. For instance, the sensor of each zone can be an infrared detector, a magnetic switch, an ultrasonic motion detector, a smoke alarm, a floor sensor or a microwaver sensors. Other sensors can be used if desired. All system events displayed on display **18** are controlled by switches **19**, **20** and **22** (FIG. **3**) of control unit **12**.

Actuating each switch **19** or **20** allows the operator to sequentially display the identifying numbers of all zones present in the system. When switch **19** is actuated, the display sequences identifying zone numbers in ascending order and when switch **20** is actuated, the display sequences down by descending identifying numbers of the zones. Switch **22** has three functions, namely, to acknowledge an alarm event, to secure a zone, or to access a zone. LED **52** mounted on push button **52** as shown in FIGS. **1** and **2** will flash and can be accompanied by a sound from sonic alert indicator **55** when an alarm event occurs. The LED will continue to flash and the sound alert indicator will continue to sound until the operator acknowledges the alarm event by actuating status switch **22**.

When control unit **12** detects an alarm event at a remote zone, such as when the sensor at the zone sends a signal along bus **25** to control unit **12**, CPU **36** receives the signal and causes specific data to be directed along data bus **40** to central portion **56** of display **18** so that the display will display the identifying number of the zone at which the alarm event occurs. Also, latch **54** is actuated to cause LED **52** to be energized and to flash. Sonic alert indicator **55** will also sound to warn of the alarm event. During an alarm event, the switches **19** and **20** are locked out so as to force the operator to acknowledge the alarm by actuating status switch **22**. In the case of muliple alarms, the numbers of the various zones in alarm are displayed sequentially in central portion **56** of the display **18**. Both the alarm and active words are flashed in portion **59** of display **18** when this occurs.

Once the alarm is acknowledged by actuating switch **22**, the sonic alert is silenced and LED **52** is deactuated. When the alarm condition is corrected, such as by deactuating the actuated sensor, the word "active" at portion **59** of display **18** goes out and the zone can be secured by actuating the status switch **22**. This action returns the zone to an access condition and the word "access" in portion **59** of display **18** will then be visible.

The word "active" on display **18** becomes visible whenever there is an alarm event at a zone and if the actuation of the sensor at the zone is continuous. The word "active" continues to be visible until the cause of that event has been corrected and the sensor is deactuated. If an alarm has been acknowledged and the active indicator appears in display **18**, the zone having the alarm may be accessed by actuating status switch **22** one time. If the zone is in alarm, but the active indicator is not present, status switch **22** must be actuated two times, once to change the status of the zone from alarm to secure and a second time to change from secure to access. An alarmed or accessed zone may be secured by actuating status switch **22** when the identifying number of that zone appears in portion **56** of display **18**.

If transponder **27** ceases to respond to the actuation of status switch **22**, such as during monitoring of the zones of the transponder, this will indicate that the line to the transponder is defective. When this occurs, the sonic alert indicator **55** will sound and the identifying numbers of affected zones of that particular transponder **26** will be displayed sequentially on display **18** with their last known status. Then, the message "comfail" will appear in portion **57** of display **18**. When the transponder **26** does eventually respond, the previous status of the zones will be restored.

Control unit **12** has a tamper annunciation portion and will detect a tamper alarm at junction box **23**, if tampering does occur. In such a case, the sonic alert indicator **55** will sound and the word "tamper" in portion **57** of display **18** will become visible and will flash on the display. The alarm state is secured automatically when the tamper alarm is no longer detected. Tamper alarms cannot be manually secured or accessed. However, the tamper condition may be acknowledged to stop the sonic alert indicator **55** and allow the actuation of status switch **22**.

If electrical power is removed from control unit **12**, the sonic alert indicator will sound and the word "power" will be displayed at portion **57** of display **18**. Operator acknowledgement is required to stop the sonic alert indicator and free the zone status switch **22** for use. When power is restored, the word "power" at portion **57** will go out.

The map displays **30** provide the operator with status information at a glance for each zone in the system. Each map display **30** is a modular unit which can contain **16** sets of three color-coded LED's **34**. For each zone, a red LED indicates alarm, a yellow LED indicates access, and a green LED indicates secure. The

map displays **30** can be rack mounted or can stand alone with control unit **12**.

FIG. **4** shows in graphic form the sequence of events during an alarm event at a particular zone in which the status changes from secure to alarm status and then the return of the status of the zone to a secure condition, either directly or through an access event. Usually, each zone, before an alarm event, will be in a secure condition indicated at portion **59** on display **18** by the word "secure". When a sensor **31** at a particular zone is actuated to cause an alarm condition, the system changes from a secure status to an alarm event status indicated by the word "alarm" at portion **59** of display **18**. Path **68** of FIG. **4** indicates the change from the secure status to the alarm event. If the sensor comprises an alarm event, there will be a sound made by sonic alert indicator **55**. Also, LED **52** on pushbutton **28** (FIGS. **1** and **2**) will flash to indicate the alarm event. If map displays **30** are used, the red LED **34** of the corresponding map display **30** will flash. If the sensor remains actuated, the word "active" is visible in portion **59** of display **18**. If the sensor is actuated only for a short duration, the word "active" is not visible.

When the alarm event occurs, the operator will actuate switch **22** indicated by path **70** to acknowledge the alarm. When this occurs, the word "alarm" remains on the display **18**, the sonic alert indicator **55** and LED **52** go off, and the red LED on the corresponding map display **30** will become a steady red. The operator can instruct a worker to go to the zone in alarm or can take other remedial action as required.

If the sensor at the zone in alarm is actuated only for a short duration, such as when a light beam is momentarily broken, actuation of switch **22** will return the zone to secure along path **74** of FIG. **4**. At this point, the system is returned to its starting condition awaiting the next alarm event. However, if the actuation of the sensor is continuous, such as when a door is opened and remains open, switch **22** is actuated and the sequence follows a path **76** to a location on the chart in FIG. **4** represented by the word "access". When this condition is reached, the sonic alert indicator **55** is off and the yellow LED **34** of the corresponding map display **30** will be a steady yellow. Finally, the next actuation of status switch **22** will cause the sequence to follow along a path **80** of the chart in FIG. **4** back to the secure position and the system will remain in secure until the next alarm event. If, in, the secure condition, a zone is monitored by actuating switch **22**, the sequence is along a path **82** back to access which will permit access or entry to the zone without causing an alarm event. The next actuation of switch **22** will return the zone to the secure condition in which the green LED **34** of the corresponding map display **30** will be steady green and the word "secure" will be visible at portion **59** of display **18**.

In summary, the status of a zone displayed on control unit **12**, the status of a particular sensor **31**, and the status of the corresponding map display **30** will be as follows during a secure condition, followed by an alarm event:

CONTROL UNIT STATUS	SENSOR STATUS	MAP DISPLAY
Secure	Secure	Green
Active Alarm	Alarm	Flashing Red

After the first actuation (path **70** of FIG. **4**) of status switch **22** following a sensor going into an alarm event, the sonic alert indicator **55** will be silenced and the LED **52** will be extinguished while the status of the zone displayed on the control unit **12**, the status of the sensor, and the status of the corresponding map display will be steady red as follows:

CONTROL UNIT STATUS	SENSOR STATUS	MAP DISPLAY
(Active) Alarm	(Alarm) Secure	Steady Red

If the sensor is still actuated after the first actuation of switch **22**, the word "active" will also be visible in portion **59** of display **18** and the sensor status will be in alarm rather than in secure.

At the second actuation of switch **22**, the status of the zone displayed on control unit **12**, the status of the sensor at the zone and the status of the map display will depend upon the conditions immediately before the second actuation of switch **22**. If the status of the zone, sensor and map display are active alarm, alarm and steady red, respectively, then the second actuation of switch **22** causes the following conditions to occur:

CONTROL UNIT STATUS	SENSOR STATUS	MAP DISPLAY
(Active) Access	(Alarm) Secure	Steady Yellow

If the sensor remains actuated, the word active remains visible in portion **59** of display **18** along with the word "access". In such a case, the sensor will continue to be in alarm rather than in secure. If the sensor is only momentarily actuated, it will be secure when the sensor is deactuated. When the zone is in access, entry to the zone can be made by a person without causing an alarm event.

If the status of the zone, the sensor and map display are, before the second actuation of switch **22**, alarm, secure and steady red, then the second actuation of switch **22** causes the following conditions to occur:

CONTROL UNIT STATUS	SENSOR STATUS	MAP DISPLAY
Secure	Secure	Steady Green

With this latter set of conditions, system **10** is ready for the next alarm event.

What is claimed is:

1. A security system for a plurality of remote security zones spaced from a central control location comprising: a central control unit adapted to be placed at said central control location; and actuatable sensor adapted to be placed at each of said zones, respectively; and means coupling the central control unit with the sensors when the sensors are at respective zones, each zone having an identifying number, said central control unit including a central processor, a display, a first switch for actuating the display under the control of the central processor to cause the identifying numbers of the zones to be sequentially displayed on the display, a second switch for actuating the display under the control of said central processor to cause the status of a zone to be displayed on the display when the identifying number of the zone is displayed on the display, the status of each

zone being changeable as a function of the actuation and deactuation of the respective sensor, whereby the status of a zone can change from a first status condition to a second status condition when the respective sensor is actuated, said second switch being actuatable under the control of the central processor to return the status of a zone displayed on said display to the first status condition when the status of the zone is in the second status condition when the sensor is deactuated after being actuated, said central processor being operable to display a symbol on the display representing an active actuation condition of a sensor when the sensor remains actuated after being actuated, the actuation of the second switch being operable to cause the central processor to display a third status condition of a zone before the status of the zone is returned to the first status condition if the sensor at the zone remains actuated after being actuated.

2. A security system as set forth in claim **1**, wherein the central processor operates to permit a zone identifying number to be entered into the display without causing a change in the status of the zone from the first status condition to the second status condition if the second switch is actuated when the status of a zone is in the first status condition before the zone is entered.

3. A security system as set forth in claim **1**, wherein is included a map display adjacent to the central control unit, said map display having three light sources for each zone, respectively, one of the light sources representing a first status condition of the respective zone, the second light suorce representing a second status condition of the zone, and the third light source representing a third status condition of the zone.

4. A security system for a plurality of remote security zones spaced from a central control location comprising: a central control unit adapted to be placed at said central control location; an actuatable sensor adapted to be placed at each of said zones, respectively; transponder means coupling the sensors with the central control unit when the sensors are at respective zones, each sensor having a secure condition and an alarm condition, each sensor being in an alarm condition after the sensor has been actuated and before it is deactuated, each zone having an identifying number associated with it, said central control unit including a central processor, a display, a pair of first switches for actuating the display under the control of the central processor to cause the identifying number of the zones to be sequentially displayed on the display, one of the first switches being operable to sequence the identifying numbers in a forward direction and the other first switch being operable to sequence the identifying numbers in a reverse direction, said central control unit further including a second, status switch for actuating the display under the control of the central processor unit to cause the status of a zone to be displayed on the display when the identifying number of the zone is displayed on the display, each zone having a secure status, an alarm status and an access status, the status of each zone being changeable from the secure status to the alarm status when a sensor at the zone is actuated, the central processor being operable to change the status of a zone displayed on the display from the alarm status to the access status when the second switch is actuated and when the actuated sensor remains actuated, the central processor being operable to change the status of a zone displayed on the display from the alarm status to the secure status when the second switch is actuated and when the sensor is thereafter deactuated, said central processor being further operable to change the status of a zone displayed on the display from the access status to the secure status when the second switch is actuated as the zone is in the access status, the central processor being operable to change the status of a zone displayed on the display from the secure status to the access status when the second switch is actuated and as the sensor of the zone remains deactuated, whereby entry to the corresponding zone will be permitted without causing the zone to be placed in an alarm status.

5. A method of monitoring a plurality of remote security zones each being capable of having a secure status, an alarm status and an access status comprising: providing an actuatable sensor at each zone, respectively; displaying the status of each zone on a visual display at a central control location; changing the status of a zone displayed on the display from a secure status indication to an alarm status indication when the sensor at the zone is actuated; providing an observable indication of the alarm status indication; returning the status of a zone corresponding to an actuated sensor to a secure status after the alarm status has been displayed on the display and the actuated sensor has been deactuated; changing the status of a zone from an alarm status to an access status when a corresponding sensor remains actuated after being actuated; and causing the change of the status of a zone from an access status to a secure status after said changing step when the corresponding sensor has been deactuated, said returning, changing and causing steps being effected by a number of actuations of a single electrical switch.

6. A method as set forth in claim **5**, wherein each zone has an identifying number, and wherein is included the step of selectively displaying the identifying number of each of said zones at said central control location.

7. A method as set forth in claim **5**, wherein each zone has an identifying number, and including the step of displaying the identifying number of a zone at said central control location when the sensor corresponding to the zone is actuated.

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